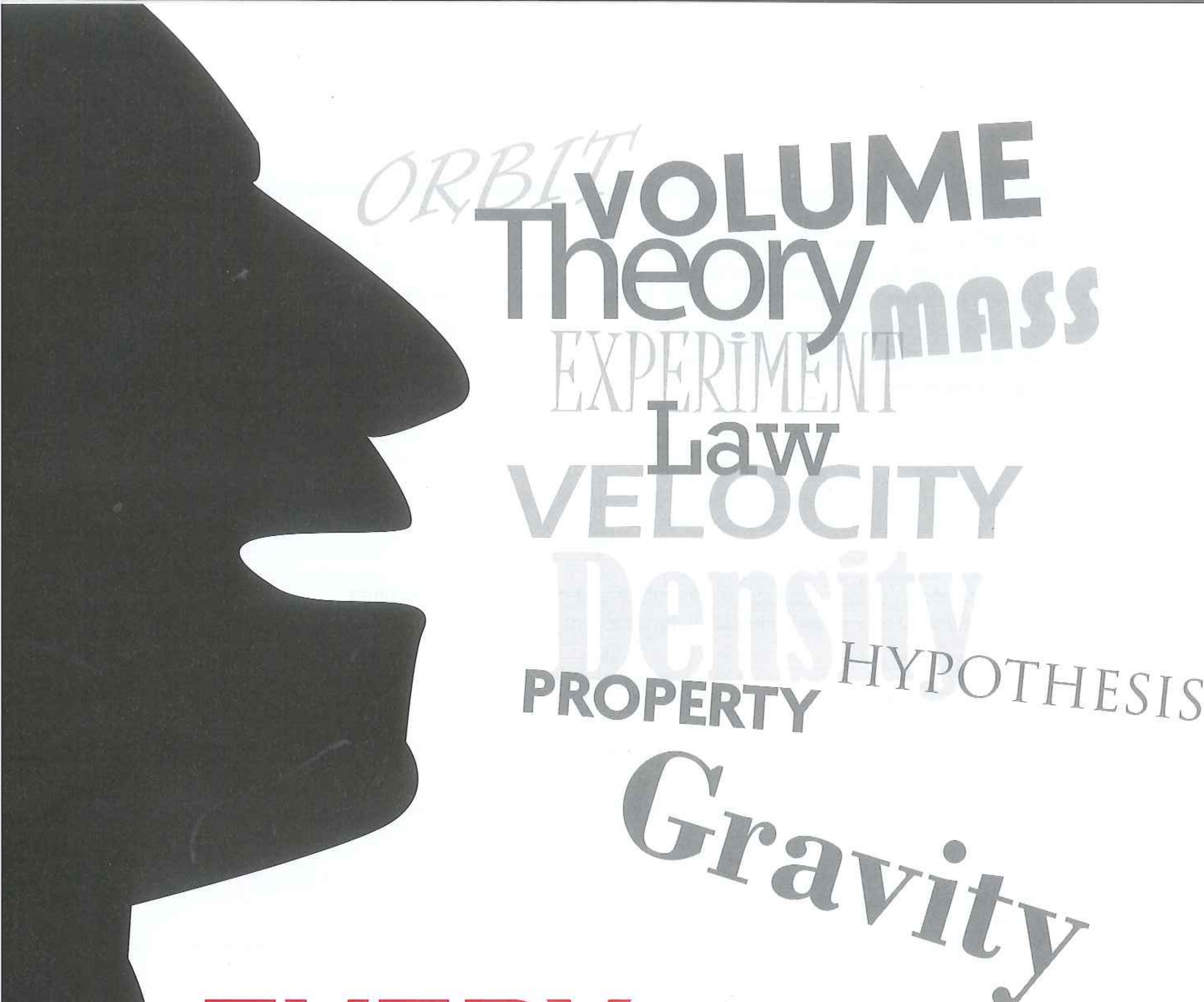

EVERY WORD YOU SPEAK

Alan Colburn and Huong Tran Nguyen

Helping English language learners swim in the science language stream

More than five million U.S. students are English language learners (ELLs), or 57% more than a decade ago (Ballantyne, Sanderman, and Levy 2008). If that growth continues, sooner or later, we will all teach ELLs. But many teachers are unprepared for this challenge. They might presume that "good teaching" helps ELLs learn content (de Jong and Harper 2008) or that an English-only environment accelerates ELLs' acquisition of academic English and content in science classes (Reeves 2006). In reality, many ELLs, without instructional support, may sink rather than swim in the language stream (de Jong and Harper 2008).

Despite our support of inquiry-based instruction (Colburn 2000, 2003), we realize that teachers devote most class time to other activities, including lectures and discussions. This article shows how teachers can use these common instructional methods to ensure that students, including ELLs, understand the language of science, construct new concepts, and simultaneously develop academic English abilities.

Making science accessible

The academic language of science involves the passive voice, abstract nouns derived from verbs (Lemke 1990), and technical terms and associated concepts (Short, Vogt, and Echevarria 2011). These stylistic conventions can make science less accessible and engaging to students, especially those who struggle with science and English.

For students to learn science, they must first understand the words teachers speak. To that end, teachers should enunciate clearly, paraphrase or repeat student responses, and avoid using idioms or colloquial terms. Hands-on activities that demonstrate concepts in concrete, visual ways are particularly beneficial for ELLs (Echevarria, Vogt, and Short 2008; de Jong and Harper 2008). For example, to demonstrate flotation, present a tank of water with objects resting on the surface. When students manipulate objects and experiment for themselves, concepts like floating, sinking, buoyancy, and density are more understandable.

Group discussion

Teachers sometimes discuss news articles about scientific or medical studies with students, a great way to discover real-life applications of course content. Typically, the teacher poses open-ended questions to the class (e.g., "What do you think of this study?"), responds to student comments, and guides class discussions of the studies and media reports.

To pose language-appropriate questions during these kinds of discussions, teachers must know ELLs' English proficiency levels. The California Department of Education's English Language Development Standards (2009) identify five language development levels:

- beginning
- early intermediate
- intermediate
- early advanced
- advanced

Students at the beginning level typically experience a silent period (Krashen 1995), in which they listen to class discussions and internalize vocabulary but don't speak. At this level, students' ability to understand may lead their ability to speak correctly (Genesee et al. 2006). Teachers and English-proficient peers can provide speech models and support for ELLs (de Jong and Harper 2008; Echevarria, Vogt, and Short 2008; Genesee et al. 2006; Goldenberg 2008), who must be encouraged to participate in class. If nothing more, ELLs can respond to "yes/no," "either/or," and discussion questions such as

- "What is the article's title?"
- "Show me ________."
- "Is this ________ or ________?"

Intermediate-level students can communicate with simple sentences and common phrases, orally and in writing, but continue to make common errors in pronunciation, word usage, grammar, and syntax (Krashen 1995). They can respond to questions like

- "What do you think is the article's main idea?" and
- "What did the scientists do?"

These students are more comfortable with basic interpersonal communicative skills. ELLs tend to linger at the intermediate stage more than previous stages; it can take five to seven years for them to gain proficiency in academic language and content in English (Cummins 2008).

Once students transition to the early advanced and advanced levels of English fluency, they can identify and summarize concrete details and abstract concepts in all content areas and communicate more easily (Genesee et al. 2006). Appropriate discussion questions for advanced students include

- "Do you think the article provides enough information to analyze the study critically? Why?" and
- "What do you think is missing? Why?"

When teachers ask questions and present information using pictures, words, and helpful nonverbal cues (e.g., gestures, expressions, demonstrations), students make better sense of the teachers' words and textbook language. In addition, sentence stems (or frames) provide a scaffold for thinking critically and using advanced academic English. Examples include

- "To analyze the article critically, I would need to read about..." or
- "To really judge the study, readers would also need to know..."

Direct instruction

Direct instruction is the most common type in high school science classrooms. Even inquiry-oriented curricular approaches such as the learning cycle (Lawson, Abraham, and Renner 1989) and the 5E—Engage, Explore, Explain, Elaborate, Evaluate—model (Bybee et al. 2006) have a place for direct instruction, as teachers help students understand and explain their observations.

In planning direct instruction, teachers need to consider how to help students learn science vocabulary. ELLs often find textbooks difficult to comprehend and "dense" with new words. ELLs cannot rely on known information or context to determine the meaning of a scientific term; they must be taught the meaning. That is, when a learner "encounters a new word in a science text, it is usually central to the mean-

FIGURE 1

Vocabulary word map.

Write your own definition of the word (in English or your native language).	List three to five synonyms and antonyms.
Use the word in a sentence.	Draw a picture of the word.

Vocabulary word or concept word

ing of the sentence and often the entire paragraph" (Short, Vogt, and Echevarria 2011, p. 8). ELLs have to achieve both the content and language objectives in lessons.

In a lesson about types of quantitative data, for example, the language objectives are to understand the terms *categoric, ordered,* and *continuous,* applying them to different types of scientific variables. The teacher could ask students to define *category* in their own words and provide examples of things they might categorize. The examples help students explicitly link the lesson's content with their prior learning and experiences (de Jong and Harper 2008; Goldenberg 2008; Short, Vogt, and Echevarria 2011).

To help students, the teacher could give them sentence stems to complete, such as

- "_____ is an example of categoric data."
- "The categories would be _____."

A student might write: "Brands of paper towels are an example of categoric data. The categories would be the different brand names."

Paraphrasing or repeating student responses allows the instructor to simultaneously define the concept in student-accessible language, subtly clarify or correct responses, and model spoken words for ELLs.

In many cases, the everyday and scientific meanings of words are similar (e.g., *volume, gravity*). Words like *theory* and *law,* on the other hand, have different meanings in science. Students struggling with academic vocabulary might fall back on nonacademic word definitions. This can reduce instructional effectiveness.

The teacher could ask students to write everyday definitions of *theory* and *law* and then come up with examples of familiar scientific theories and laws, brainstorming responses in pairs or small groups. During the discussion, each student could write a response (the name of a theory or law), then pass the paper to the next group member (an activity often called *Rally Table*). Students share their group lists with the whole class, saying, for example

- "My partner thinks _____________________."
- "I agree with my partner about ___________, but I also think __________ because _________________."

Rather than putting students on the spot, this technique encourages them to listen to their partners or fellow group members and synthesize their answers. The teacher can discuss how scientists articulate the theories and define the terms in contrast to students' definitions. Teachers should make clear that many words—including nonacademic terms—have multiple meanings. *Table,* for example, has different meanings in English, science, and math.

Teachers can give each pair or small group graphic organizers (Figures 1 and 2) to record their answers. Not every student is skilled in note taking: Some may need guidance to determine which lecture notes are essential to copy and prepare for their upcoming quiz or exam (Nguyen 2007). Teachers should circulate around the room to offer assistance.

Teachers can also scaffold students by teaching and listing "signal words" to help students recognize and understand various types of text structures found in science textbooks and required for writing assignments. For instance, if students are asked to describe or list, they may want to use words such as *in addition, moreover, furthermore,* and *first of all.* Words like *first, second, third, then, next, after that,* and *finally* can help students describe sequence or order (Short, Vogt, and Echevarria 2011, pp. 33–34).

Conclusion

Learning academic content and skills while simultaneously developing English proficiency is a complex, multifaceted challenge. Therefore, we must work to maximize learning for *all* students—cultivating students' voices, stimulating their minds in critical-thinking ways, and continually improving our own teaching repertoires. It's worth the effort. ■

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FIGURE 2

Vocabulary organizing chart.

Vocabulary word or concept word	Textbook definition (formal)	Student's definition (informal [this can be written in his or her native language])	Illustration, picture, or symbol	Antonym, synonym, or nonuse	Vocabulary usage in a context or sentence

Idea Bank

April/May 2012, Tips and Techniques for Creative Teaching

The Snowball Questioning Method

You've probably called on students in class only to have them stare in silence, quickly respond "I don't know," or blush in embarrassment. I've had such responses from many students—especially English language learners (ELLs) and special education students. As students become increasingly diverse in language and learning abilities, teachers must look for new ways to include all of them in class discussion.

Class discussion can be a great method of formative assessment and a way to develop a community of science learners (NRC 1996). Questioning students has a significant positive effect on their achievement (Hattie 2009); the benefits of questioning include immediate feedback, increased comprehension, thoughtful reflection, and higher levels of academic achievement.

I developed the "snowball" questioning method in an environmental science course for juniors and seniors made up of approximately 30% special education students, 10% ELLs, and 80% students not planning to attend a four-year college. Learners' special needs included low reading ability, attention deficits, behavioral problems, autism, and speech impediments.

My goal was to regularly engage all students in class discussions and improve the quality of their responses. I used techniques such as "No Opt Out" (Lemov 2010), in which students who answer incorrectly or with "I don't know" are asked to repeat the correct answer after another student provides it. These techniques helped to engage students and make sure they heard the correct answer but didn't improve students' initial answers or the frequency of their voluntary responses.

Next, I questioned students who rarely participated. They told me they thought they knew the answers to most of my questions but worried that they were incorrect. When asked in what setting they would be comfortable speaking up, they answered "in small groups." I started to formulate a method of questioning that would allow students to build confidence in their answers before sharing them with the class.

I started with the Think-Pair-Share technique (Lyman 1981), in which students think silently about a question before pairing with a classmate to discuss it. Then, I took it further, inspired by the idea of a snowball rolling downhill, gaining mass and momentum. The snowball would start rolling when I asked a question in class. Students would then pair up to discuss their answers with partners, and the snowball would grow bigger.

I used the snowball technique during a unit on biomagnification, a topic that's new to most students and somewhat difficult to understand. After discussing food chains and the loss of energy being transferred from one trophic level to the next, I asked students to predict what would happen if a contaminant like mercury were added to algae and moved up the food chain until ingested by eagles.

I gave students 30 to 60 seconds to formulate their answers; this critical, often-overlooked wait time allowed them to ponder their answers independently without being distracted by peers raising their hands. After students formed their answers, they discussed them for one to two minutes in pairs. Once pairs arrived at common answers, they joined another pair. In groups of four, students discussed their final answers for another one to two minutes. At this point, students had thought about their answers for three to five minutes, instead of just a few seconds, and discussed them twice in small groups, gaining confidence in stating their answers out loud.

At the end of the small-group discussion, a spokesperson shared each group's answer with the class. The spokesperson was selected by some random characteristic, such as the person wearing the most blue or having the nearest birthday. As groups shared their answers, I asked if group members initially had the same or differing answers. We then reviewed the discussions that led to their final answers.

Eventually, I shared the scientifically accurate answer. At first, many students believed the mercury would become diluted in animal tissues, instead of more concentrated, as it moved up the food chain. This misconception was dispelled by the group and whole-class discussions.

As groups shared their answers, I noted which groups got it right and which had incomplete or inaccurate answers. I also noted how groups developed their answers. This allowed me to discuss biomagnification in more detail and break down why some answers were inaccurate. Otherwise, group discussions could reinforce misconceptions.

This activity increased the quality of answers shared in discussions and the likelihood that ELLs and special education students would participate.

Students were seated so they could easily speak to their assigned partners. Groups were based on academic level and English proficiency (i.e., groups of four had two proficient students and two nonproficient).

The snowball questioning method has worked well in my class. I rarely hear "I don't know" anymore. Special education students and ELLs are more engaged. I've seen improvement on quizzes and tests. For example, in the ecology unit, the number of failing quizzes dropped from about 13% in previous years to zero last year, after we used the snowball method. This efficient method of questioning students brings quick feedback, revealing how well they understand a topic. It also helps develop a community of science learners and makes science more accessible to every student in the class.

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